Ambient Pressure Scanning Tunneling Microscopy Studies on Model Catalysts; Restructuring of CO-induced Clusters on Stepped Pt(557) Surface at Elevated Temperature

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The modern industrial catalysts have been improved their catalytic activity with selectivity by various engineering technologies of top-down or bottom-up way. In most industrial catalysts, chemical reactions occur on nanoparticle surfaces with kink and step sites. Stepped single crystal metal surface is, therefore, a representative model system which is closely connected to real catalyst. In this study, we investigated CO oxidation reaction on (557) oriented platinum (Pt) surface with ambient pressure scanning tunneling microscopy. The oxidized Pt clusters are formed at the step edge of Pt(557) surface, which reacts with repulsive CO free molecules at the elevated temperature up to 150 °C. The grain shape of Pt clusters attractive each other by tilted adsorbate CO-induced Pt atoms at near ambient pressure condition from few mTorr to 1 Torr range, and they almost disappear as gradually after evacuation of filled gas molecules. This restructuring phenomenon implies that chemical reactions are occurred on step site of Pt(557) by surface clusters diffusion at environmental condition. We will discuss the role of reaction site and surface oxide on the stepped surface which influence to industrial catalytic reactions at atomic-scale level.

In addition, I will address the role of Pt oxide of Pt nanoparticles on oxide supports on the catalytic activity was monitored using in-situ FTIR (Fourier Transform Infrared) spectroscopy. We synthesized silica supported metal nanoparticle using Pt metal coated by layer of titania. This design provides high catalytic activity due to enhanced support-metal interactions. We carried out in-situ spectroscopic studies for CO oxidation of oxide stabilized platinum metal. These experiments are to elucidate the role of surface oxide on Pt nanoparticles and the interaction between the metal oxide and metal that determines the catalytic activity of heterogeneous catalysis.